**INSTRUCTOR GUIDE**

**ACTIVITY TITLE: Are you In Control?**

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| \***Theme**: | Motor control of the body and reflexes |
| \***Objective**(s):*(What key learning do you want students to come away with?)*  | -Reflexes and pure spinal cord regulation-Predictive and inhibitory functions of the brain -This regulation can be subconscious |

 **LESSON OUTLINE:**

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| **1. Introduction:***Plan a script of what you will say to start.**- What will this be about? Why’s it interesting?* *(Hook)* | Many of the things we do on an everyday basis happen without us having to consciously think about how to move our bodies. How do these basically “automatic” activities of the motor system interact with higher-level control from the brain, like being able to play tennis?Some automatic actions or reactions could be dropping a hot Poptart right when it comes out of the toaster, or picking up your foot if you step on a rockSome higher-level actions are: hitting a tennis ball with a raquet, or lifting a heavy box. Today, we will look at two different activities that illustrate this relationship: A **strength-regulation, which you can control,**  and **knee-jerk activity, which is a reflex you cannot control.** We want to use these activities to think about all the ways that our brain regulates and coordinates these lower-level activities. |

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| **2. Building Background:***List questions you can use to immediately engage your audience and prepare their thinking for your activity.**-What prior knowledge might they have about/related to your topic?* *-What prior knowledge (background) do they need for your activity?* | (More for the strength regulation)Have you ever tried to tickle yourself? Why is it that it doesn’t work, even for the most ticklish person? How come we’re not able to feel what we do to ourselves as ticklish, even if we try? *What makes it different when you expect what’s coming?* (More for the knee-jerk) Have you ever had that feeling of climbing down stairs and forgetting there was one extra step? Was it scary? What happens in that sudden moment when you become aware of where your foot is, and how it is *not where you expected it to be?* **The knee-jerk reflex** takes place entirely within spinal cord circuitry. It senses the stretching of the patellar tendon, and simultaneously tenses the extensor muscles in the leg while tightening the flexors. This makes it an important part of an automatic balancing system (tie this in to the climbing down stairs example?) |

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| **3. Lesson & Activity:***Outline the key components of your lesson.***Plan/Note**:- key ideas/ vocabulary- scaffolds - images/media- extension questions\*Consider how to best deliver your content! \*Plan interactive components that encourage active thinking in your students. | **[Strength-Regulation Activity]*** Ask them to hold out their hand, close their eyes, and place the weight in their hand.
* Tell them that at some point, they’re going to feel the weight release, and they have to try to limit their hand moving upwards.
* Have a setup that can measure the upwards deflection of hand.
	+ It should prove very difficult to refrain from having some degree of upward hand deflection.
* Then, ask them to remove the weight themselves
	+ It should be much easier for them not to have their hand deflet upwards.
* **Why does your hand deflect upwards?** (Think about antagonistic muscles, the bicep and tricep working against each other for stiffness)
* **What is the difference between when someone removes the weight for you, and when you do it yourself**? Why can you stop yourself from moving your hand up only in one of the cases?

Extension:* Try with open eyes, see if it’s any easier.

**[Knee-Jerk Activity]*** Ask them to sit on the table, as they’ve done at the doctor’s
* Have a setup that can measure the upwards deflection of the foot upon triggering of the reflex
* Trigger the reflex (aim below the kneecap-this might take a little practice)
* **What has to happen with the antagonistic muscles to get the knee to kick out?**
* If you try and trigger the reflex on your own leg, it should still be about the same strength (predictive effects don’t seem to play a role)
* **What does this tell us about how the weight-regulation task and the knee jerk reflex might be different?** (Different types and complexities of circuits)

Extension:* Now, ask kids to carry out the **Jendrassik Maneuver:** clasp the hands in front of the chest and pull, tight, while clenching the teeth.
* The reflex with the Jendrassik Maneuver engaged should be stronger.
* **What does this tell us about the normal strength of the knee-jerk response?** (it is being inhibited by top down control)
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| **4. Wrap Up:***- Review key ideas**- Share takeaways and final thoughts**- Discuss connections to other questions and ideas. Extensions.**- Ask: Who could you teach what you learned here today?**- Ask/Suggest: What can I do to learn more?* | * How might the way we control our body differ from a robot? (Antagonistic muscle structures)
* Controlling our body is not just about moving it, but also about predicting how it might move, and compensating for that
* If our predictions are good enough, we don’t have to worry about things like walking, breathing, etc, and we can carry out more and more complex activities.

Connection to Mark’s Climbing Activity: thinking about how muscles are working there.  |

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| **MATERIALS NEEDED: *\*\*(please list all items and quantities necessary for preparation)*** |
| [Strength Regulation]-Weights (~2.5-10lbs)-Buckles for weight release[Knee-Jerk]-Tiny Hammers[Both]Deflection Measurement |

\*\*attach any printouts to end of document here

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| **Other Notes**  |
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**Extra Resources:**